

REMARKS

Applicants acknowledge with thanks the rejoinder of claims 19 to 21 with Group I, such that Group I includes claims 1 to 21, 24, and 25. By the instant amendment, claims 1 to 6, 17, 19, and 25 have been amended, new claims 26 and 27 have been added, and claims 24 and 25 have been cancelled without prejudice or disclaimer. Claims 1 to 21 and 24 to 27 are in the case.

Support for the amendment to claims 1 to 6, 17, 19, and 25 can be found throughout the specification. Support for new claim 26 can be found in the specification at, for example, page 27, lines 19 to 20 and 32, wherein it is taught that soil may be treated with H₂ gas at a concentration of 500 ppm and a flow rate of 100 mL/min (i.e., a H₂ concentration 1000X greater than air), and that such H₂-treated soil can be mixed with untreated soil at a 5% proportion, which corresponds to a H₂ concentration 50X greater than air. Support for new claim 27 can be found in the specification at, for example, page 7, line 27, and Example 2.

Specification

The Examiner raised an objection to the specification, noting an extra “p-value” in Table I at page 11. Applicants have corrected the table, and taken the opportunity to amend the heading “Growth enhance” under “Shoot” to read --Growth Enhance--. Withdrawal of the objection is respectfully requested.

Drawings

The Examiner raised an objection to the Y-axis labels on Figures 1 and 2. Applicants submit herewith replacement Figures 1 and 2, in which the Y-axes have been relabelled --Growth Enhancement (% greater than air)--, as suggested by the Examiner. Withdrawal of the objection is respectfully requested.

Claim Rejections Under 35 USC § 103

The Examiner rejected claims 1, 4, 6, 7, 16, 18, 19, and 24 under 35 USC § 103(a) as unpatentable over the Atmosphere in view of Buckman et al.

Insofar as the rejection might apply to the claims as amended herein, the rejection is respectfully traversed for the following reasons.

The Examiner was of the opinion that the cited references disclose soil being exposed to H₂ gas, and a plant growing in such soil, because air, being a mixture of gases including hydrogen, occupies soil pores not occupied by water. Applicants agree that air contains H₂ gas, albeit at very low concentrations (in the order of 0.5 ppm), and that soil in contact with air is in contact with the H₂ gas in air. However, Applicants' invention comprises more than simply contacting soil and air containing H₂ gas. Rather, the invention requires that soil be treated with H₂ gas.

Accordingly, as amended herein, claims 1 to 6, 17, 19, and 25 recite that soil is *treated* with H₂ gas. Treating soil with H₂ gas is distinct from contact between soil and H₂ gas in air in at least two fundamental ways. Firstly, treatment of soil with H₂ gas is an active process, whereas contact between soil and H₂ in air occurs passively. Secondly, treatment of soil with H₂ gas according to the invention requires that H₂ gas be applied to soil in excess of the H₂ in air. This is readily apparent upon reading the specification, because, for example, all experiments described therein were conducted in air; hence, for H₂ treatment of soil, excess H₂ (i.e., relative to H₂ in air) was added. Moreover, in experiments described in the specification, air was used as the control to evaluate growth-enhancing effects of treating soil with H₂. The data indicate that air had no growth-enhancing effect on soil, which confirms that air contact is not equivalent to H₂ treatment of soil.

The cited references do not teach or suggest the claimed method of treating soil with H₂ gas for the purpose of enhancing plant growth or yield. The "Atmosphere" simply states that air contains hydrogen, and Buckman et al. simply states that soil pore spaces contain air, and that plants grow in soil. The references are silent as to any role of H₂ gas in plant growth or yield. Hence the references provide no motivation to treat soil with H₂ gas in accordance with the invention.

In view of the foregoing, withdrawal of the rejection under 35 USC § 103(a) and reconsideration are respectfully requested.

Claim 7 was rejected on the grounds that, in light of claim 1, it would have been obvious to modify the methods of Atmosphere and Buckman et al. to have H₂ gas generated by electrolysis. Applicants submit that this rejection is rendered moot in view of claim 1 as amended herein. Withdrawal of the rejection and reconsideration are respectfully requested.

The Examiner rejected claim 16 on the grounds that, in light of claim 1, it would have been obvious to modify the methods of Atmosphere and Buckman et al. to grow plants in plastic pots for ease of plant husbandry. Applicants submit that this rejection is rendered moot in view of claim 1 as amended herein. Withdrawal of the rejection and reconsideration are respectfully requested.

Claim 18 was rejected on the grounds that, in light of claim 1, it would have been obvious to modify the methods of Atmosphere and Buckman et al. to grow plants in a field with drainage tiles to promote soil drainage, wherein the tiles inherently contain H₂ gas. Applicants submit that this rejection is rendered moot in view of claim 1 as amended herein. Withdrawal of the rejection and reconsideration are respectfully requested.

Claim 19 was rejected on the grounds that, in light of claim 1, it would have been obvious to modify the methods of Atmosphere and Buckman et al. so that when soil is exposed to H₂ gas, the exposure enhances the ability of soil microbes to oxidize H₂, which, in turn, enhances plant growth or yield. Applicants disagree. It is respectfully submitted that the Examiner's assertion that "microbes exposed to an reduced (energy) source enhance the pathway for the oxidization of that source and it is inherent that these microbes enhance plant growth and yield" is simply not true. In fact, there is no inherent link between a microbe's oxidization of an energy source and growth enhancement of a plant; indeed, some microbes are plant pathogens. Thus, prior to the invention, there was no motivation in the art to enhance a microbe's oxidation of an energy source, using H₂, to enhance plant growth or yield.

Prior to the invention, there was, at best, only limited understanding in the art of what happens to H₂ in soil, with some agreement that H₂ is oxidized by soil microbes (see page 5, lines 3 to 19 of the specification). However, prior to the invention, there had not been established any link between soil oxidation of H₂ by microbes and plant growth or yield. The present inventors have made the important discovery that it is this oxidation of H₂ that enhances plant growth or yield, and that this enhancement can be promoted by treating soil with H₂. No combination of the state of the art and the cited references teaches or even suggests H₂ treatment of soil to enhance H₂ oxidation by soil microbes and to enhance plant growth or yield.


In view of the foregoing, withdrawal of this rejection and reconsideration are respectfully requested.

Claim 24 was rejected in view of Atmosphere as modified by Buckman et al. Applicants respectfully submit that the rejection is improper. Atmosphere is deficient because it simply teaches that the atmosphere is a mixture of gases including hydrogen. Buckman et al. does not repair the deficiency of Atmosphere because it discusses the relationship between plants and nitrogen-fixing bacteria in the soil, as a means by which plants obtain nitrogen, but does not even mention H₂ in this process. Accordingly, withdrawal of the rejection and reconsideration are respectfully requested.

Applicants submit that claims 1 to 21 and 24 to 27 are in condition for allowance and look forward to receiving a Notice of Allowability in the near future. Should the Examiner wish to discuss this application, he is requested to call the undersigned agent at (613) 533-2342.

Please deduct any fee(s) which may be required from our deposit account No. 17-0110.

Respectfully submitted,



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